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U.S. PATENT APPLICATION

Inventors: **Roger SOUDERS**
Randy WILLIS

Invention: **BALL BATS AND METHODS OF MAKING THE SAME**

NIXON & VANDERHYE P.C.
ATTORNEYS AT LAW
1100 NORTH GLEBE ROAD
8TH FLOOR
ARLINGTON, VIRGINIA 22201-4714
(703) 816-4000
Telecopier (703) 816-4100

SPECIFICATION

BALL BATS AND METHODS OF MAKING THE SAME

FIELD OF THE INVENTION

The present invention relates generally to the field of ball bats used in sports games, and to methods of making the same. In especially preferred forms, the present invention is embodied in ball bats whereby the barrel and handle components of the bat are constructed from two separate structural components and united to one another in such a way to promote both ease of manufacture and improved performance.

BACKGROUND OF THE INVENTION

The design and construction of non-wood bats has predominately been focussed on aluminum alloys and, to a lesser extent, composite materials such as graphite and glass fibers in an epoxy resin matrix. Historically, these conventional bats have been formed of a one-piece construction wherein the handle and the barrel are formed as a unitary (one-piece) structure, with the handle knob and barrel end cap being attached as separate structural components.

Performance of bats is primarily measured in terms of the speed at which the ball rebounds from the barrel. Over the years, bat manufacturers have made design changes to increase ball speed thus improving the performance of the bat. The principal way that ball speed has been increased is by thinning the wall in the barrel of the bat to increase the spring or trampoline effect when the ball impacts the barrel. An increase in ball speed could be obtained by modifying the barrel's circumferential flexibility due to the stiff transition between the barrel's tapered proximal end and the relatively thick-walled handle. As a result,

design efforts to increase bat performance has focused on thinning the wall of the barrel to produce the desired spring effect noted previously.

The challenge to making one-piece thin wall aluminum bats is to have high performance and good durability. Persistent significant problems of barrel denting have occurred for high performance bats having relatively thin-walled barrels. Bat manufacturers have attempted to solve such problem by careful selection of aluminum alloys, but such attempts have not met with complete success.

Bats constructed of composite materials, such as graphite, fiberglass and/or aramid fiber-reinforced epoxy resins, have not met with much commercial success. In this regard, the designers of composite bats have followed the same design objectives to produce thin walled flexible barrel bats as described above. The impact strength of composite materials is much less than that for aluminum and aluminum alloys and thus it has been difficult to match the barrel flex of aluminum without breakage. As a result, composite material bats have been produced with a stiffer barrel which lacks the performance characteristics of the aluminum bats having flexible thin-walled barrels.

Recently, a two-piece bat construction has been proposed in U.S. Patent No. 5,593,158 to Filice et al (the entire content of which is incorporated expressly by reference herein). According to this prior proposal, the handle and barrel are separate structural components having conforming taper segments with an elastomeric isolation union disposed therebetween. This elastomeric isolation union provides the only connection between the handle and the barrel and is said to reduce shock transmitted from the handle to the hands of a user when a ball is hit with the bat.

SUMMARY OF THE INVENTION

Broadly, the present invention is embodied in ball bats and methods of making the same whereby the handle and barrel are separate structural components and whereby the handle member is of sufficient length to extend through the hollow barrel. As such, the handle member may be connected to the barrel member at its proximal and terminal ends. Preferably, the connection between the handle member at the proximal end of the barrel member is via an elastomeric connector. On the other hand, the connection between the handle member and the distal end of the barrel member is most preferably accomplished by means of embedding the terminal end of the handle member in a barrel end plug which is connected to and closes the distal end of the barrel member. The barrel end plug is also most preferably formed of an elastomeric material. Such structure allows the handle member to be a substantially constant diameter along the entirety of its length, thereby improving its flexural response.

Unlike the increasing diameter taper associated with conventional handle members of two-piece bats, the handle member of the present invention may be provided with a substantially constant diameter along substantially its entire length. As such, the handle member may be made more flexible to produce a flexural response that will influence the speed of the ball off the barrel of the bat. In addition, the handle member can be "engineered" for different flexural responses to allow the bat to be tailored to individual power hitters. Using the flexural response of the handle member to influence ball speed off the barrel enables the barrel wall to be thickened to thereby increase barrel strength which in turn resists denting in bats made of aluminum alloys and breakage in bats made of composites, without sacrificing bat performance.

These and other aspects and advantages will become more apparent after careful consideration is given to the following detailed description of the preferred exemplary embodiments thereof.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

Reference will hereinafter be made to the accompanying drawings, wherein like reference numerals throughout the various FIGURES denote like structural elements, and wherein;

FIGURE 1 is a perspective view of an especially preferred ball bat in accordance with the present invention;

FIGURE 2 is a perspective cross-sectional view of the ball bat depicted in FIGURE 1 as taken along line 1-1 therein;

FIGURE 3 is an enlarged cross-sectional view of an intermediate region of the ball bat in accordance with the present invention showing a connection between an intermediate region of the handle member and a proximal end of the barrel member;

FIGURE 4 is an enlarged cross-sectional view of a terminal end region of the ball bat in accordance with the present invention showing a connection between the distal ends of the handle and barrel members; and

FIGURE 5 is an enlarged cross-sectional view of a terminal end region of the ball bat in accordance with the present invention showing an alternative connection between the distal end of the handle member and the distal end of the barrel member thereof.

DETAILED DESCRIPTION OF THE INVENTION

An especially preferred embodiment of a ball bat 10 in accordance with the present invention is depicted in accompanying FIGURES 1 and 2. As shown therein, the bat 10 generally includes a barrel section 12 which includes a cylindrical hollow barrel member 12-1 having a tapered proximal end 12-2 and an open distal end 12-3. A handle section 14 which includes a smaller-diameter tubular handle member 14-1 extends proximally of the barrel section 12. An intermediate region 14-2 (see FIGURE 2) of the handle member 14-1 is structurally joined to the proximal end 12-2 of the barrel member 12-1 by means of a connector 16. A proximal region 16-1 of the connector 16 surrounding the intermediate region 14-2 (see FIGURE 2) of the handle member 14-1 provides a visibly smooth tapered transition between the larger-diameter barrel member 12-1 and the smaller-diameter handle member 14-1. The visible portion of the handle member 14-1 which proximally extends from the connector 16 thus establishes the handle region 14 which is adapted to be gripped by a batter during use. As is conventional, a knob 18 is fixed to the proximal end of the handle section 14 to assist holding the bat during use. A barrel end plug 20 is fixed to and closes the open distal end 12-3 of the barrel member 12-1.

As is perhaps shown best in accompanying FIGURE 2, the handle member 14-1 is comprised of a one-piece (unitary) tubular structural component having a diameter that is less than that of the barrel member 12-1. Important to the present invention, the handle member 14-1 includes a distally extending internal support region 14-3 located physically within the hollow of the barrel member 12-1 and establishing an internal annular space 22 therewithin. Thus, the one-piece handle member 14-1 is coaxially positioned with respect to the barrel member 12-

1 and has a length sufficient to establish the proximally extending handle region 14 and the distally extending internal support region 14-3.

As noted briefly above, the intermediate region 14-2 is joined physically to the proximal end 12-2 of the barrel member 12-1 via the connector 16. As shown in the enlarged view of FIGURE 3, the connector 16 thus includes a distal portion 16-2 which occupies a portion of the annular space 22 established between the intermediate region 14-2 of the handle member 14-1 and the tapered distal end 12-2 of the barrel member 12-1. The proximal portion 16-1 of the connector provides a visibly smooth transition between the taper of the distal end 12-2 of the barrel member 12-1 and the smaller-diameter handle region 14 extending proximally thereof.

The terminal end of the handle member 14-1, and hence the terminal end of the internal support region 14-3, is embedded physically within the barrel end cap 20 as shown in the enlarged view of FIGURE 4. Therefore, the handle member 14 is also connected physically to the distal end 12-3 of the barrel member 12 via the barrel end plug 20. As such, the handle member 14 is connected physically to the barrel member 12 at both the proximal and distal ends 12-2 and 12-3, respectively, of the latter.

The barrel and handle members 12, 14, respectively, may be constructed of a variety of materials conventionally employed in the art for making ball bats. Thus, the barrel member 12 and handle member 14 may be made of the same or different metal or non-metal material. If constructed of a metal, aluminum and aluminum alloys are preferable. If constructed of a non-metal, a fiber-reinforced composite material is most

preferred, such as a thermoplastic resin or thermoset epoxy resin reinforced with fibers formed of graphite, glass and/or Kevlar® aramid.

The connector 16 and the barrel end plug 20 may be formed of rigid or elastomeric materials as may be desired by the bat designer to achieve particular bat performance properties. Most preferably, however, both the connector 16 and barrel end plug 20 is constructed of a reasonably hard solid, but elastomeric, material so as to provide shock absorption and/or isolation properties. Most preferably, each of the connector 16 and barrel end plug 20 is made from a moldable urethane, such as FLEXANE® urethane commercially available from ITW Devcon of Danvers, MA.

The weight of the connector 16 and barrel end plug 20 can be varied to achieve the desired weight, balance and swing weight of the bat. In addition, although the handle member 14 has been shown and described herein as being of substantially constant cross-sectional diameter, it may be desirable to taper the handle member 14 so that one region of the handle member 14 is of a different diameter as compared to another region thereof. Thus, it may be desirable if the internal support region 14-3 of the handle member 14 was tapered, which tapering can occur proximally or distally relative to the intermediate region 14-2.

Accompanying FIGURE 5 depicts another possible connection between the terminal end of the internal support region 14-3 of handle member 14 and the distal end of the barrel member 12-1 that may be employed in the present invention. In this regard, it will be observed that the interior of the barrel member 12-1 includes a connection disc 30 proximally of the barrel end plug 20. The terminal end of the internal support region 14-3 is thus connected to the connection disc 30 which

therefore joins such terminal end to the distal end of the barrel member 12-1.

The connection disc may be positioned within the barrel at a location from about mid-way of the barrel member's length to its terminal end thereof. Although the connection disc 30 is depicted in FIGURE 5 as being positioned close to, but proximally spaced from, the barrel end plug 20, the disc 30 and end plug 20 may be abutted against one another if deemed desirable and/or necessary for a particular bat design.

As with the connector 16 and barrel end plug 20, the connection disc 30 may be formed of a rigid or elastomeric material.

The relative hardness of the connector 16, barrel end plug 20 and, if employed, the connection disc 30, may be the same or different as compared to one another so as to achieve the desired performance parameters for the bat. When using elastomeric materials, the connector 16, barrel end plug 20 and connection disc 30 may have durometer hardness values, which may be the same or different, of between about 25 shore A to about 99 shore A, preferably between about 80 shore A to about 95 shore A, and advantageously between about 90 shore A to about 95 shore A.

While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.